PENNSYLVANIA COASTAL ZONE MANAGEMENT PROGRAM

TECHNICAL REPORT

Delaware Estuary Fish Consumption Survey

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Patterns of Sport-fish Consumption

at Six Pennsylvania Sites Along the Tidal Portion

of the Delaware River

with Special Emphasis on Shore Anglers

By

Ann Faulds[1], Nancy Connelly[2], Barbara A. Knuth[2], Jill Benowitz[1] , Joe Matassino[3], and Kevin P. Norton[4]

[1]Penn State University
Pennsylvania Sea Grant
1450 Edgmont Avenue
Suite 150
Chester, PA 19013

[2]Human Dimensions
Research Unit
117 Fernow Hall
Cornell University
Ithaca, NY 14853

[3]Partnership for the
Delaware Estuary
400 West 9th Street
Suite 100
Wilmington, DE

[4]Penn State University
0100 Glenhill Farmhouse
Penn State Erie Behrend
Erie, PA 16563

EXECUTIVE SUMMARY

Polychlorinated biphenyl (PCB) and mercury contamination in the Pennsylvania portion of the Delaware Estuary has made it necessary for the Commonwealth of Pennsylvania to issue health advisories to inform the public about safe limits for consuming recreationally caught fish. To assess the effectiveness of this voluntary management strategy, it is important to know about consumer advisory awareness and adherence to recommended consumption practices. This study was designed to improve the knowledge of recreational fish preparation and consumption patterns so that audience specific outreach and education could be designed to enhance the existing advisory risk communication process.

Because shore anglers' consumption is typically higher than boating anglers, our survey focused mainly on shore angler habits, but we did sample some boat anglers for comparison. We sampled at 6 fishing access locations along a the Pennsylvania portion of the Delaware River between Neshaminy State Park and Barry Bridge Park, a tidal portion of the Estuary.

We developed a roving survey methodology following Pollack *et al*. (1994) with instantaneous counts to estimate shore angler effort, continuous counts for boat angler effort, and on-site interviews to estimate trip length, catch, fish consumption behavior and angler attitudes.

The study timeframe was May 1, 2003 through August 31, 2003. Our stratified sample design, with interview shifts allocated to sites and dates within this timeframe, was based on our desire to have an adequate sample at each site and an adequate number of interviews for analysis by ethnicity. Weight factors were calculated for use in the analysis of interview data to adjust for the stratified nature of the sampling. Thus, overall weighted data should reflect users of the area and not over or under represent certain ethnic groups.

During the study period, 192 shifts and 1035 interviews were completed. One hundred and thirty-seven of the interviews were with boat anglers. An additional 474 interviews were attempted, but anglers had already participated so the interviews were not repeated. Only 67 anglers refused to be interviewed, about half of whom appeared to have difficulty understanding English and many of whom were Asian. We estimated over 11,800 fishing trips occurred during the study. The average fishing trip length was 3.2 hours for shore anglers and 4.6 hours for boat anglers.

Anglers of 22 nationalities were interviewed, but 94% of the shore anglers were identified as belonging to one of five ethnic groups: white American, Afro American, Puerto Rican, Vietnamese, or Cambodian. Boat anglers, who consist largely of white Americans, were considered an additional angler group that had much in common with white American shore anglers. Since our study purpose was primarily for directing future outreach activities, we focused our analysis on these 6 angler audiences.

Site fidelity, or anglers reporting they fished at just one location, ranged from 35% among white Americans and boat anglers to 79% among Cambodian anglers. Site fidelity generally decreased with northerly direction, with Neshaminy Park having the lowest rate of anglers

who reported that they only fished at that location. About a third of the anglers interviewed did not display a fishing license on their outer garments as required by the Pennsylvania Fish and Boat Commission.

Anglers' residences at all sites were found to be aggregated most densely in zip code areas surrounding their fishing locations. Spatial arrangement of anglers by ethnicity also demonstrated zip codes of high densities that were generally close to the fishing locations where anglers were interviewed.

Anything that bites, striped bass and catfish were the most commonly mentioned targets by both shore and boat anglers. Although the overall percentage of the day's catch that shore anglers reported keeping was low, a much higher rate was reported among Vietnamese, Afro American and Cambodian anglers. Harvest rates reported by white American shore and boat anglers were similar and low. Overall, 19% of shore anglers and 7% of boat anglers reported that someone in their household ate the fish they caught. Consistent with harvest reports, Afro American, Cambodian, Puerto Rican and Vietnamese anglers reported much higher rates of eating wild fish than white Americans. Reports of catch and release rates generally followed inversely to consumption rates, and white Americans gave away fish to friends and strangers less often than other nationalities.

Within the households of shore anglers who ate fish, there was an overall high rate of consumption, with very little variation among major nationalities or age classes. An average of 3.7 recreational fish consumers resided in each household, so for each angler who brings home fish to eat, about 2.7 additional people also ate those wild fish. One hundred seventy children and women of childbearing age, or 39% of the total household members, were reported by anglers to consume wild Delaware Estuary fish.

Channel catfish, white perch, striped bass and carp were the most frequently consumed fish species, with little variation among nationalities reported. Consumption rates that were above the recommended frequency advised by the 2003 Pennsylvania advisory were commonly reported among shore anglers who eat Delaware River wild fish. Of those who eat Delaware River wild fish, proportions of over-consumption ranged from just over 16% of white Americans to two-thirds of Cambodians, and Vietnamese shore anglers who reported consuming one or more fish in the year previous to the interview at a rate above the 2003 Pennsylvania recommended limit. Anglers reported eating an average of 2.9, and as many as 7 different types of fish, in the year previous to the interview. However, cumulative consumption above recommended levels across species was not analyzed.

Overall patterns of employment for boat anglers appear very similar to those of shore anglers. Fish consumption did not appear to be higher among the unemployed as we might have expected. However, a surprising proportion of white and Afro American anglers who ate fish were retired, while virtually no retired Cambodian, Vietnamese or Puerto Rican anglers were encountered in our survey. While most white and Afro American anglers reported cooking their own catch, most Asian anglers responded that their wives cooked the fish they caught. All 8 of the boaters in the survey who ate fish reported that they cooked the fish they caught.

There was similar ethnic variation in preparation and cooking methods. White and Afro American anglers tended to trim the fat from the belly or back more often than Cambodian and Vietnamese anglers. Most anglers interviewed skin catfish before cooking, with a somewhat lower rate reported by Cambodians and Vietnamese. Most white Americans remove the skin from other finfish, while most Afro American, Cambodian and Vietnamese did not. The majority of anglers cook the entire fish gutted. Very few anglers reported eating fish parts such as the liver or kidney. Vietnamese reported a very high rate of freezing, drying or canning fish for later use, compared to white and Afro American respondents.

The high frequency and rates of consumption among angler groups may relate to low advisory awareness. The majority of shore anglers were not aware of the Pennsylvania fish consumption advisory before being interviewed, with awareness spanning from a low among Vietnamese anglers to a high among white American anglers. Boat anglers exhibited the highest rate of advisory awareness.

Attitudes about how safe fish were to consume differed by whether the respondent actually consumed fish from the Delaware River, with those who consumed fish more likely to believe the fish were safer than those who did not consume fish. This was particularly true among consuming Afro American, Cambodian, and Puerto Rican anglers where three-quarters or more thought Delaware fish were just as safe as those bought in a store or restaurant. Concern about the safety of eating wild fish generally mirrored angler attitudes about safety. Three-quarters of Cambodian anglers and almost half of Afro American anglers who ate fish were not at all concerned about the health risks of eating Delaware River fish.

We believe this to be the first consumption survey of its kind conducted in the Pennsylvania portion of the Delaware Estuary and a first effort at identifying and characterizing the major nationalities of anglers in the greater Philadelphia area. We found an angler intercept survey was particularly appropriate for reaching the Afro American, Vietnamese, Cambodian and Puerto Rican populations we encountered in the field who might have been underrepresented in other types of surveys. While unique patterns of consumption and attitudes emerged for each ethnic group, we might characterize the whole group as neighborhood recreational fishermen (only a few women were found to fish) many of whom were zealous about eating the fish they caught and shared with their households. Based on patterns of employment and the frequency of consumption reported, we feel the vast majority of the anglers we surveyed were not fishing out of an economic need to augment their diet.

Our study identified a substantial number of anglers and their household members, more than a third of whom were children and women of child bearing age, who ate Delaware River fish at frequencies above recommended and without knowledge of the Pennsylvania advisory. Increasing advisory awareness among at-risk individuals should be the highest priority in crafting a risk communication message for the target ethnic groups we identified. We also found that preparation methods were often not consistent with the methods assumed in the Pennsylvania advisory. Improving preparation methods should also be addressed in a safe

consumption campaign, featuring preparation methods that reduce fat-soluble contaminants such as PCBs. Also stressed should be the benefits and risks associated with eating locally caught wild fish, as well as advice specific for children and women of child bearing age, since they represented a significant portion of people who consume fish. Since anglers on average eat 2.9 different types of Delaware Estuary fish each year, awareness of the cumulative effects of eating all types of fish should also be stressed. The authors offer outreach and risk communication recommendations to reach at risk audiences.

INTRODUCTION

Polychlorinated biphenyl (PCB) and mercury contamination in the Pennsylvania portion of the Delaware Estuary has made it necessary for the Commonwealth of Pennsylvania to issue health advisories to inform the public about safe limits for consuming recreationally caught fish. Along with long-term remediation and control activities, issuing fish consumption advisories is the primary management strategy being used in the Delaware Estuary to protect recreational anglers and their household members from the possible health problems resulting from ingesting fish contaminants. Such a strategy is largely voluntary for fish consumers, used instead of stricter restrictions such as bans on fishing or possessing fish. A management strategy based on voluntary compliance presumes that potential fish consumers are aware of the recommendations, understand them, and have enough knowledge to make an informed decision to abide by, modify or reject the recommendation (Knuth 1990).

To assess the effectiveness of this voluntary management strategy, it is important to know about consumer advisory awareness and adherence to recommended consumption practices. However, in the Pennsylvania portion of the Delaware Estuary, very little is known about angler awareness of these advisories, or the fishing, cooking, and eating habits of anglers and their households, important factors that contribute to fish consumption health risk. This study was designed to improve the knowledge of recreational fish preparation and consumption patterns so that audience specific outreach and education could be designed to enhance the existing advisory risk communication process.

Because shore anglers' consumption is typically higher than boating anglers, our survey focused mainly on shore angler habits, but we did sample some boat anglers for comparison. To determine Delaware River angler attitudes and patterns of consumption of recreationally caught fish, our survey investigated the following questions:

- What was the shore fishing effort at six popular locations in the Pennsylvania portion of the Delaware Estuary?
- What nationality are the recreational anglers? What languages do they speak and where do they reside?
- What kind of fish are targeted and caught and what do anglers do with the fish they catch? Who prepares the fish and how is it cooked?
- How do these behaviors differ among anglers of different nationalities?
- What are angler attitudes about the safety of eating wild fish and what is their awareness of Pennsylvania fish advisories? How does this awareness differ among anglers of different nationalities?

METHODS

Our sampling strategy was chosen to accomplish two research objectives simultaneously. First, we wanted to estimate shore fishing effort (and to a lesser extent boat fishing effort) along a stretch of the Delaware River on the Pennsylvania side, between Barry Bridge Park (called Rt. 322) and Neshaminy State Park, a tidal portion of the estuary. Second, we wanted to conduct interviews with enough anglers so that analysis could be done by ethnicity. To accomplish these objectives we developed a roving survey methodology following Pollack *et*

al. (1994) with instantaneous counts to estimate shore angler effort, continuous counts for boat angler effort, and on-site interviews to estimate trip length, catch, fish consumption behavior and angler attitudes. Appendix A contains the questionnaire used.

Study Area

We chose 6 sites within the tidal portion of the Delaware Estuary that had the same 2003 Pennsylvania PCB advisory for white perch, flathead catfish, striped bass and carp (1 skinned and trimmed 8 ounce meal per month), channel catfish (6 meals per year) and American eel (do not eat). The 2003 advisory also recommended eating smallmouth bass no more than twice a month and all other recreationally caught fish no more frequently than once a week due to mercury contamination. The study area included access points on the Pennsylvania side of the Delaware River between Neshaminy State Park in Bucks County and Barry Bridge Park in Delaware County (below the Route 322 bridge). The points in between were Linden Avenue, Pennypack Park, Frankford Arsenal, and Hog Island (Figures 1-6). Shortly after the study began we determined that Hog Island needed to be divided into two sub-sites because it was not possible to do instantaneous angler counts for the entire site on busy days. We also determined that use levels at Rt. 322 were very low and, for efficiency's sake, we stopped allocating shifts to the site, but conducted instantaneous counts during half of the Hog Island shifts instead.

The study timeframe was May 1, 2003 through August 31, 2003. Interview shifts were allocated to sites and dates within this timeframe based on our desire to have an adequate sample at each site and an adequate number of interviews for analysis by ethnicity. It was determined through preliminary site visits that Hog Island attracted the most Asian anglers, but had a low overall use level, so half of the available shifts were allocated to this site. The other half were allocated primarily to Frankford Arsenal, where it was believed many Hispanic and Afro American anglers fished, then originally to Rt. 322 and Pennypack for Afro American anglers. When use was found to be low at Rt. 322, the remaining Rt. 322 shifts were reallocated to other sites.

Recreational fishing effort is typically highest on weekends and holidays, thus we stratified sampling days into two types: (1) weekdays; and (2) weekend days and holidays. Shifts were divided equally between the two types. Dates were chosen randomly without replacement from within a type then assigned to an access site described above. Within each day, three non-overlapping interview periods were defined: 8AM to noon, noon to 4PM, and 4PM to 8PM. Shifts were assigned randomly to one of the three time periods for weekend and holidays. For weekday shifts, non-uniform probabilities of .25 for the 8AM – noon shift, .25 for the noon - 4PM shift, and .50 for the 4PM – 8PM shift were used to select the shift time period.

Angler effort was estimated using the methodology laid out by Pollack *et al*. (1994). Estimates were made by weekday versus weekend for each site, then aggregated for the entire river section. Standard errors were calculated, as well as the relative (proportional) standard error (Jessen 1978), allowing for comparisons with a recent creel survey conducted by Versar (Volstad *et a*l. 2003). Weight factors were calculated for use in the analysis of interview data to adjust for the stratified nature of the sampling design (primarily the

purposeful selection of sites for ethnic diversity and not use level). Thus, overall weighted data should reflect users of the area and not over or under represent certain ethnic groups. Unless otherwise noted, all shore angler data presented are weighted, and all boat angler data are raw figures, which we presented in order to make general comparisons of attitudes and patterns of consumption among angler groups. All data were entered and managed in a MS Access database, and ArcView 8.3 was used to generate maps indicating where angler groups resided.

RESULTS

Angler Effort

During the study period, 192 shifts and 1035 interviews were completed (Table 1). One hundred and thirty-seven of the interviews were with boat anglers. An additional 474 interviews were attempted, but anglers had already participated so the interviews were not repeated. Only 67 anglers refused to be interviewed, about half of whom appeared to have difficulty understanding English and many of whom were Asian (n=21). The average fishing trip length was 3.2 hours for shore anglers and 4.6 hours for boat anglers. Comparable estimates from the Versar, Inc. creel survey (Volstad *et al.* 2003) were 2.6 hours for shore anglers and 4.3 hours for boat anglers in the tidal portion of their study area. Total fishing effort was estimated in hours then divided by hours per trip to obtain estimates of the number of trips.

Total estimated effort for shore anglers is detailed in Table 2. Effort was greatest at Hog Island and least at Rt. 322. The standard error and relative standard error (RSE) are quite small, due in large part to the number of shifts worked at each site. The overall estimated effort for shore fishing in the study area was 11,824 trips during the study period.

Boat anglers were counted at Frankford, Linden, and Neshaminy using an access point survey design. However, post-survey analysis indicated that the number of shifts and perhaps the counting methods used by field staff were insufficient to allow reliable estimates of boat angler effort. This also prevented us from being able to weight the boat angler interviews; consequently, all data from the 137 boat angler interviews we report are raw figures. Unless otherwise noted, all shore angler data presented are weighted.

Characterizing Angler Audiences

Anglers of 22 nationalities were interviewed (Table 3), but 94% of the shore anglers were identified as belonging to one of five ethnic groups: white American, Afro American, Puerto Rican, Vietnamese, or Cambodian. Boat anglers, who consist largely of white Americans, were considered an additional angler group that had much in common with white American shore anglers. Since our study purpose was primarily for directing future outreach activities, we have focused our analysis on these 6 potential angler audiences. Language comprehension for these nationalities followed as expected, with 84% of Cambodian, 72% of Vietnamese, and 59% of Puerto Rican anglers reporting that they comprehended their native language the best and the remainder reported understanding English the best. White and Afro Americans all reported that they read and understood English the best.

Site fidelity, or anglers reporting they fished at just one location, ranged from 35% among white Americans and boat anglers to 79% among Cambodian anglers (Table 4). Site fidelity generally decreased with northerly direction, with Neshaminy Park having the lowest rate of anglers who reported that they only fished at that location. About a third of the anglers interviewed did not display a fishing license on their outer garments as required by the Pennsylvania Fish and Boat Commission, however, this proportion should serve only as an estimate of the proportion of unlicensed anglers because the interviewers were instructed not to ask if anglers had a license (to prevent being mistaken for a law enforcement agent).

Figures 1-6 illustrate the residential densities by zip code areas reported by anglers. Anglers' residences at all the locations were found to be aggregated most densely in zip code areas surrounding their fishing locations. A very few white anglers reported living in New Jersey and no anglers reported living in Delaware. Spatial arrangement of anglers by ethnicity also demonstrated zip codes of high densities that were generally close to the fishing locations where anglers were interviewed (Figures 7 - 12).

Target species and what anglers did with their catch

Anything that bites, striped bass and catfish were the most commonly mentioned targets by both shore and boat anglers (Table 5). Shore anglers appeared to be generally less specific about what they were after, and boat anglers reported largemouth bass more often as a target species.

Although the overall percentage of the day's catch that shore anglers reported keeping was low, a much higher rate was reported among Vietnamese, Afro American and Cambodian anglers (Table 6). Harvest rates reported by white American shore and boat anglers were similar and low. Overall, 19% of shore anglers and 7% of boat anglers reported that someone in their household ate the fish they caught. Consistent with harvest reports, Afro American, Cambodian, Puerto Rican and Vietnamese anglers reported much higher rates of eating wild fish than white Americans (Table 7). Reports of catch and release rates generally followed inversely to consumption rates, and white Americans gave away fish to friends and strangers less often than other nationalities. Within the households of shore anglers who ate fish, there was an overall high rate of consumption, with very little variation among major nationalities or age classes (Table 8). An average of 3.7 recreational fish consumers resided in each household, so for each angler who brings home fish to eat, about 2.7 additional people also ate those wild fish. One hundred seventy children and women of childbearing age, or 39% of the total household members, were reported by anglers to consume wild Delaware Estuary fish.

Channel catfish, white perch, striped bass and carp were the most frequently consumed fish species. Very little variation among nationalities was reported (Table 9). Consumption rates that were above the recommended frequency advised by the 2003 Pennsylvania advisory were commonly reported among shore anglers who eat Delaware River wild fish (Table 10). Of those who eat Delaware River wild fish, proportions of over-consumption ranged from just over 16% of white Americans to two-thirds of Cambodians, and Vietnamese shore anglers who reported consuming one or more fish in the year previous to the interview at a rate above the 2003 Pennsylvania recommended limit. By analyzing these same data a

different way, to look at the frequency of consumption reported for specific fish, consumption at levels above the advised rate were very high in all four of the most frequently consumed fish (Table 11). Anglers reported eating an average of 2.9, and as many as 7 different types of fish, in the year previous to the interview. However, cumulative consumption above recommended levels across species was not analyzed.

It should also be noted that, while field interviewers only observed channel catfish being caught, there seemed to be uncertainty about reports of other species of catfish caught and consumed. Landings of flathead catfish were unconfirmed in this study, and it is suspected that large channel catfish were sometime referred to as flathead catfish, an introduced species that is much more common in the Schuylkill drainage that the tidal portion of the Delaware and for which a different fish consumption advisory exists. Adding to the confusion is an unconfirmed report of a white catfish catch.

Overall patterns of employment for boat anglers appear very similar to those of shore anglers (Table 12). Fish consumption did not appear to be higher among the unemployed as we might have expected. However, a surprising proportion of white and Afro American anglers who ate fish were retired, while virtually no retired Cambodian, Vietnamese or Puerto Rican anglers were encountered in our survey.

How the fish was prepared and cooked

Table 13 summarizes the ethnic variation in who cooks wild caught fish. While most white and Afro American anglers reported cooking their own catch, most Asian anglers responded that their wives cooked the fish they caught. All 8 of the boaters in the survey who ate fish reported that they cooked the fish they caught.

Table 14 presents similar ethnic variation in preparation and cooking methods. White and Afro American anglers tended to trim the fat from the belly or back more than Cambodian and Vietnamese anglers. Most anglers interviewed skin catfish before cooking, with a somewhat lower rate reported by Cambodians and Vietnamese. Most white Americans remove the skin from other finfish, while most Afro American, Cambodian and Vietnamese did not. The majority of anglers cook the entire fish gutted. Almost everyone reported that they never ate fish that have not been gutted. Very few anglers reported eating fish parts such as the liver or kidney. Vietnamese reported a very high rate of freezing, drying or canning fish for later use, compared to white and Afro American respondents. Anglers were also asked if they skinned eel before preparing, but post-interview analysis found it was a leading question so it was eliminated.

Advisory awareness and angler attitudes

The high frequency and rates of consumption among angler groups may relate to low advisory awareness. The majority of shore anglers were not aware of the Pennsylvania fish consumption advisory before being interviewed (Table 15), with awareness spanning from a low among Vietnamese anglers to a high among white American anglers. Boat anglers exhibited the highest rate of advisory awareness.

Attitudes about how safe fish were to consume differed by whether the respondent actually consumed fish from the Delaware River (Table 16). Those who consumed fish were more likely to believe the fish were safer than those who did not consume fish. This was particularly true among consuming Afro American, Cambodian, and Puerto Rican anglers where three-quarters or more thought Delaware fish were just as safe as those bought in a store or restaurant.

Concern about the safety of eating wild fish generally mirrored the results presented above. Those anglers who ate fish were less concerned about the potential health risks to their families from consuming Delaware caught fish than those who did not eat fish (Table 17). Three-quarters of Cambodian anglers and almost half of Afro American anglers who ate fish were not at all concerned about the health risks of eating Delaware River fish.

DISCUSSION AND RECOMMENDATIONS

We believe this to be the first consumption survey of its kind conducted in the Pennsylvania portion of the Delaware Estuary and a first effort at identifying and characterizing the major nationalities of anglers in the greater Philadelphia area. We found an angler intercept survey was particularly appropriate for reaching the Afro American, Vietnamese, Cambodian and Puerto Rican populations we encountered in the field who might have been underrepresented in other types of surveys. While unique patterns of consumption and attitudes emerged for each ethnic group, we might characterize the whole group as neighborhood recreational fishermen (only a few women were found to fish) many of whom were zealous about eating the fish they caught and shared with their households. Based on patterns of employment and the frequency of consumption reported, we feel the vast majority of the anglers we surveyed were not fishing out of an economic need to augment their diet. The angler audience we did encounter should be highly receptive to a safe consumption campaign including catch-and-release fishing if tailored to the constituent ethnic groups.

Crafting a safe consumption campaign

Our study identified a substantial number of anglers and their household members, more than a third of whom were children and women of child bearing age, who ate Delaware River fish at frequencies above recommended and without knowledge of the Pennsylvania advisory. Increasing advisory awareness among at-risk individuals should be the highest priority in crafting a risk communication message for the target ethnic groups we identified. We also found that preparation methods were often not consistent with the methods assumed in the Pennsylvania advisory (that skin and belly fat be removed). Improving preparation methods should also be addressed in a safe consumption campaign, featuring preparation methods that reduce fat-soluble contaminants such as PCBs. Also stressed should be the benefits and risks associated with eating locally caught wild fish, as well as advice specific for children and women of child bearing age, since they represented a significant portion of people who consume fish. Since anglers on average eat 2.9 different types of Delaware Estuary fish each year, awareness of the cumulative effects of eating all types of fish should also be stressed.

We propose to develop easy-to-understand, densely illustrated printed materials to effectively communicate current Pennsylvania fish consumption advice in four languages for the five

target ethnicities, Caucasian, Afro American, Vietnamese, Cambodian and Puerto Rican. Point-of-access approaches might be the most effective at sites with high angler fidelity. We would also like to evaluate the use of on-site signage to inform anglers about the fish advisories in an angler friendly way. Other site-specific programs we are considering include riverside safe cooking demonstrations. Recipes and samples would be given away to draw people's attention to the educational message about safe fish consumption practices. Indoor venues might be a better approach to reach other at risk individuals, such as Asian wives who prepare wild fish. For this audience, we propose to use the ArcView maps to identify zip codes areas most densely populated by the various target audiences.

We further purpose to use media education to reinforce program activities. Editors of ethnic newsletters and newspapers, which in the Philadelphia region include El Hispano, La Actualidad, the Philadelphia Tribune, as well as some smaller publications targeting the Asian communities, would be invited to a workshop identifying the risk some members of their community may be facing. Sports editors of larger publications like the Philadelphia Daily News, as well as some recreational magazines, such as the Fly Fisherman and the Pennsylvania Angler and Boater Magazine should also be targeted.

We are also evaluating the feasibility of developing other printed communications such as: *Is Seafood Safe?,* a series of articles and press releases for syndication in small organizational newsletters; and health care provider brochures available in different languages – one version geared for the health care professional, another geared for the patient. We also envision having a workshop to further the knowledge of the health care providers, particularly those who serve at-risk audiences our survey identified.

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Tables and Figures

Table 1. Number of boat and shore interviews conducted at each of the 6 study sites. Shore data are weighted and boat data are raw.

Location	Shore Interviews	Boat Interviews
Neshaminy	127	35
Linden	114	31
Pennypack	143	
Frankford	190	71
Hog Island	284	
322	40	
Total	898	137

Table 2. Total daytime fishing effort for shore anglers with estimates of precision (standard error, RSE).

Location	Effort (hours)	Standard Error	RSE	# trips
Neshaminy	5402	938	0.17	1672
Linden	4858	831	0.17	1504
Pennypack	6083	571	0.09	1883
Frankford	8080	457	0.06	2502
Hog Island	12079	1150	0.1	3740
Rt. 322	1691	391	0.23	523
Area Shore Total	38193	1892	0.05	11824

Table 3. Nationality of shore and boat anglers interviewed in the study. Shore data are weighted and boat data are raw.

Nationality	Shore interviews	Boat Interviews
White American	527	128
Afro American	175	3
Vietnamese	57	
Puerto Rican	44	2
Cambodian	39	
Unknown	12	4
Chinese	6	
Guatemalan	6	
West Indian	4	
Russian	4	
Laotian	4	
Philippine	4	
Ukrainian	3	
Thai	3	
Cuban	3	
Polish	2	
Indonesian	1	
Jamaican	1	
Samoan	1	
Portuguese	1	
Brazilian	1	
Columbian	1	
Dominican	1	
Total	898	137

Table 4. Percentage of shore and boat anglers who responded that they only fished at the location where they were interviewed (site fidelity). Shore data are weighted and boat data are raw.

Site Name	Shore	Boater
Neshaminy	18%	23%
Linden	49%	42%
Pennypack	32%	
Frankford	38%	40%
Hog Island	61%	
322	60%	
Total	44%	36%
Nationality	Shore	Boater
Cambodian	79%	
Vietnamese	73%	
Afro American	46%	
Puerto Rican	46%	
White American	35%	35%
Total	42%	36%

Table 5. Target fish species reported by shore and boat anglers. If anglers mentioned more than one target species, all were included in the tabulation. All flathead and channel catfish responses were combined because most anglers were not specific. Shore data are weighted and boat data are raw.

Target fish	Shore Responses	Boat Responses
Anything that bites	54%	23%
Striped bass	21%	30%
Catfish	20%	30%
Carp	2%	0.1%
White perch	2%	1%
Largemouth bass	0.3%	8%
All others	2%	8%

Table 6. Percentage of the day's fish catch that anglers reported they kept. Shore data are weighted and boat data are raw.

	Percentage of fish kept	
Nationality	Shore	Boat
Cambodian	38%	
Vietnamese	67%	
Afro American	36%	
Puerto Rican	7%	
White American	5%	3%
Total	10%	3%

Table 7. What anglers reported doing with the fish they caught from the Delaware River. Because anglers could do a variety of things with their catch, rows may not add-up to 100%. Shore data are weighted and boat data are raw.

	What do you do with the fish you catch?				
Nationality	Someone in my household eats	Release	Give to friends	Give to strangers	Sell
Cambodian	38%	46%	23%	10%	0.00%
Vietnamese	29%	56%	20%	8%	0.00%
Afro American	43%	52%	31%	12%	0.00%
Puerto Rican	19%	70%	21%	6%	0.00%
White American	8%	85%	3%	9%	0.39%
Shore total	19%	74%	12%	10%	0.24%
Boat total	7%	88%	5%	5%	0.00%

Table 8. Percentage of household members reported by shore anglers to eat Delaware River fish. Results are presented relative to age class and nationality (of anglers interviewed who ate fish, n = 119, household members, including anglers n = 442). Data presented are weighted.

	Percent who eat by age class			
Nationality	0-15	16-45	46+	Total percentage
Cambodian	73%	90%	100%	85%
Vietnamese	93%	100%	100%	97%
Afro American	85%	99%	91%	94%
Puerto Rican	100%	78%	76%	84%
White American	69%	81%	86%	80%
Total	82%	92%	89%	89%

Table 9. The rate of consumption that shore anglers reported for various Delaware River fish. The values within the table are the weighted number of anglers who reported eating a certain type of fish at a particular frequency (what anglers recalled eating in the year previous to the interview). Anglers reported eating an average of 2.9 different types of fish during the year, so the total number of consumption reports is 303 (angler n=119).

		Meals per year		Meals per month				Total number of anglers who consumed species
Nationality	Type of Fish	5 or <	6	1	2	4	8 or >	
Cambodian	White perch		3	8				10
	Channel catfish		1	4	1	1	1	9
	Striped bass			1	1	3		6
Cambodian Total			4	13	3	5	1	25
Vietnamese	Channel catfish		3	4		1	5	13
	Striped bass		3	3		1		6
	White perch		1		3	1		5
	Carp						1	1
Vietnamese Total			6	6	3	4	6	25
Afro American	Channel catfish	5	25	6	8	15	7	66
	White perch		6	3	6	8	11	33
	Striped Bass	1	14	3		1	7	25
	Carp		5		1	8	5	19
	Small mouth bass	1	4	1	4	1	5	15
	Flathead catfish		3		1	4	5	13
	Eel		3		1			4
	White catfish		1					1
Afro American Total		7	60	12	20	37	40	175
Puerto Rican	Striped bass	1	2				1	4
	Channel catfish		1	1		1		3
	Carp			2			1	3
	White perch			2				2
	Small mouth bass			1				1
Puerto Rican Total		1	3	6		1	2	13
White American	Striped bass	1	17	4	4	1		26
	Channel catfish	1	4	6	2	4		17
	Flathead catfish			1	2	3		6
	Small mouth bass		1	3				3
	Carp		2			1		3
	White perch			1	2			3
	Rock bass						2	2
	Sunfish						2	2
	Trout		2					2
	Shad		1					1
White American Total		2	27	13	10	9	4	64
Total		11	99	50	35	55	53	303

Table 10. Percentage of shore anglers who reported eating one or more fish at a rate above the Pennsylvania advisory. Data presented are weighted (n=110).

Nationality	Percentage
Cambodian & Vietnamese	65%
Afro American	56%
White American	16%

Table 11. Frequency of fish consumption reported by shore anglers who ate Delaware River fish. Amounts are shown relative to the 2003 Pennsylvania consumption advisory shown by grey shading. Any number to the right of the grey box is considered to be over consumption of that species. Data presented are weighted (n=121).

	Meals per year			Meals per month				Number of shore anglers who reported eating species	Percentage of meals consumed that are above advised rate
Fish	0	5 or <	6	1	2	4	8 or >		
Channel catfish		6	35	28	11	24	15	118	66%
Striped bass		3	40	14	5	8	9	80	16%
White perch			14	16	10	11	12	64	52%
Carp		2	7	2	2	9	7	28	64%
Smallmouth bass		1	4	7	4	2	5	23	30%
Flathead catfish			3	1	3	7	5	18	83%
Eel			3	1	1			5	100%
Rock bass							2	2	100%
Sunfish							2	2	100%
Trout			2					2	0%
Shad			1					1	0%
Total		12	110	68	36	61	57		

Table 12. Employment status reported by major nationality and fish consumption status of shore and boat anglers (shore n = 832, boat n = 137).

		Employed in the week previous to interview?			
Nationality	Eat fish?	Yes	No	Retired	Rather not say
Cambodian	no	84%	10%	0%	5%
	yes	72%	19%	0%	9%
Vietnamese	no	75%	25%	0%	0%
	yes	85%	8%	0%	8%
Afro American	no	71%	22%	6%	0%
	yes	61%	14%	25%	0%
Puerto Rican	no	80%	20%	0%	0%
	yes	86%	14%	0%	0%
White American	no	76%	13%	11%	0%
	yes	72%	7%	21%	0%
Shore total		75%	14%	10%	1%
Boat	no	82%	6%	12%	0%
	yes	90%	10%	0%	0%
Boat totals		82%	7%	11%	0%

Table 13. Who cooks the wild fish caught by anglers in the Delaware River (shore n = 143, boat n = 8).

	Male		Female			
Nationality	Self	Parent	Spouse	Self	Grandparent	Child
Cambodian & Vietnamese	35%	0%	61%	0%	0%	0%
Afro American	54%	6%	33%	3%	2%	2%
White American	85%	0%	13%	2%	0%	0%
Shore total	58%	3%	34%	2%	1%	1%
Boat total	100%	0%	0%	0%	0%	0%

Table 14. Summary of the frequency of various preparation and cooking methods reported by shore anglers.

Nationality	1= Never	Rarely, sometimes & usually (2-4) combined	5=Always
How often do you trim or remove the fat along the belly or back?			
Cambodian & Vietnamese	46%	20%	34%
Afro American	35%	13%	52%
White American	13%	8%	78%
Total	31%	13%	56%
How often do you remove the skin of catfish?			
Cambodian & Vietnamese	18%	18%	64%
Afro American	5%	6%	90%
White American	0%	0%	100%
Total	7%	7%	86%
How often do you remove the skin of other finfish?			
Cambodian & Vietnamese	94%	11%	38%
Afro American	41%	90%	27%
White American	6%	52%	61%
Total	27%	65%	41%
How often do you eat the entire fish gutted?			
Cambodian & Vietnamese	25%	8%	75%
Afro American	31%	16%	53%
White American	20%	0%	80%
Total	27%	10%	67%
How often do you eat the entire fish not gutted?			
Cambodian & Vietnamese	100%	0%	0%
Afro American	100%	0%	0%
White American	91%	0%	9%
Total	97%	0%	3%
How often do you use fish parts such as liver or kidney in cooking?			
Cambodian & Vietnamese	89%	5%	5%
Afro American	90%	9%	2%
White American	99%	1%	0%
Total	92%	6%	2%
How often to you freeze, dry or can fish for later use?			
Cambodian & Vietnamese	32%	48%	20%
Afro American	18%	76%	6%
White American	46%	54%	0%
Total	28%	65%	7%

Table 15. Percentage of shore and boat anglers who were aware of the Pennsylvania consumption advisory before being interviewed.

Nationality	Percentage Aware
Cambodian	18%
Vietnamese	10%
Afro American	31%
Puerto Rican	19%
White American	52%
Shore total	41%
Boat total	63%

Table 16. Angler perceptions about the safety of eating Delaware River fish compared to store bought or restaurant fish. Responses are shown relative to nationality and if the angler consumed wild fish. Data presented are weighted.

Nationality	Eat fish?	Not as safe as store or restaurant fish	Just as safe as store or restaurant fish	Safer than store or restaurant fish
Cambodian	no	82%	12%	5%
	yes	28%	72%	0%
Vietnamese	no	75%	25%	0%
	yes	54%	46%	0%
Afro American	no	81%	18%	1%
	yes	16%	77%	6%
Puerto Rican	no	98%	2%	0%
	yes	15%	85%	0%
White American	no	93%	7%	0%
	yes	47%	45%	8%
Shore total		79%	20%	1%
Boat	no	91%	9%	0%
	yes	50%	40%	10%
Boat total		88%	11%	1%

Table 17. Angler level of concern that eating fish caught from the Delaware River may have potential health risks for their families. Results are presented relative to nationality and if anglers consumed wild fish.

Nationality	Eat Fish?	Very concerned	Somewhat concerned	Not at all concerned
Cambodian	no	46%	49%	5%
	yes	9%	17%	74%
Vietnamese	no	50%	37%	13%
	yes	0%	69%	31%
Afro American	no	74%	19%	7%
	yes	12%	41%	46%
Puerto Rican	no	89%	6%	5%
	yes	0%	66%	39%
White American	no	87%	12%	2%
	yes	15%	55%	32%
Shore total		68%	21%	11%
Boat	no	95%	4%	1%
	yes	0%	80%	20%
Boat total		88%	10%	2%

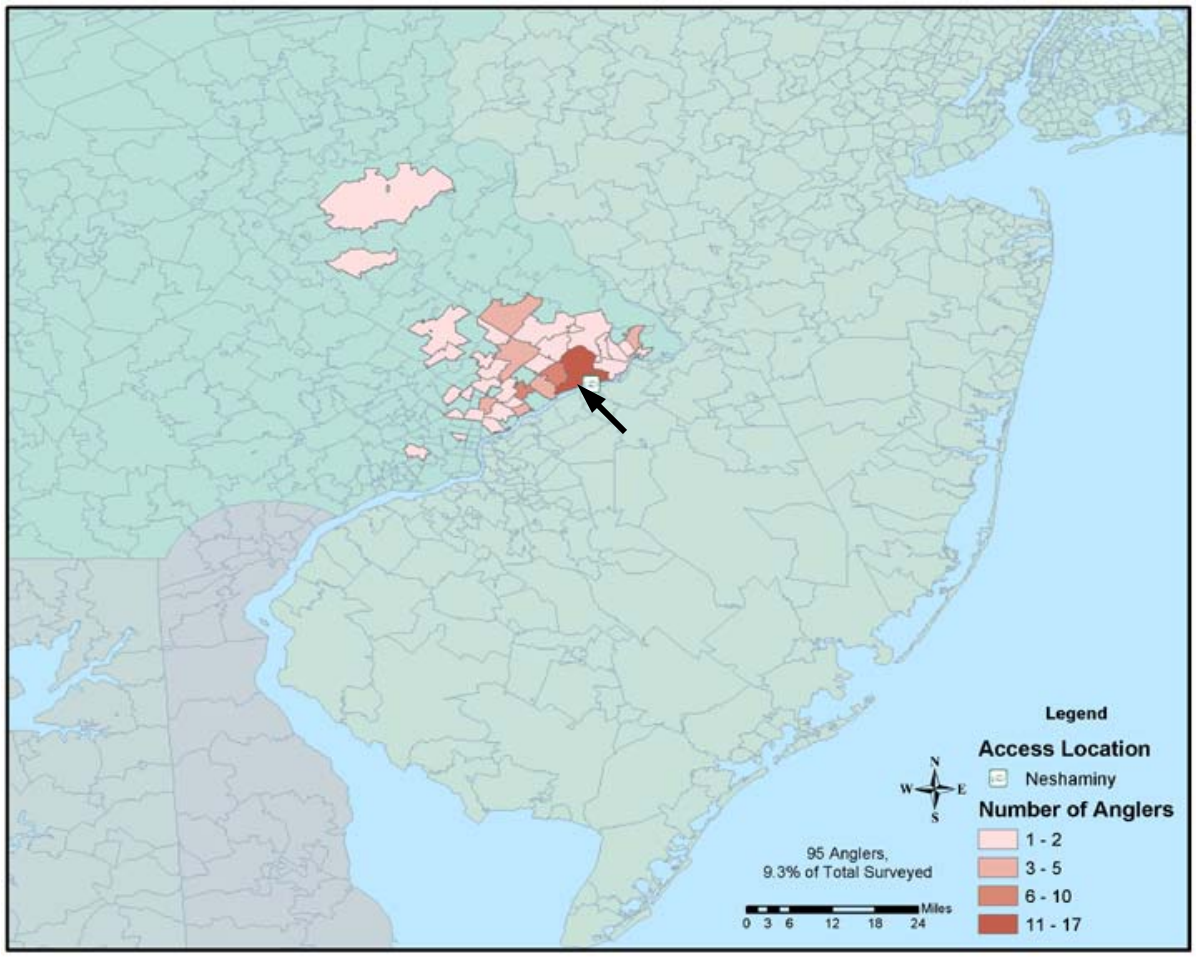

Figure 1. Residential densities by zip code areas as reported by anglers who were interviewed at Neshaminy State Park, Bucks County, PA. An arrow indicates the site location. Raw data are presented.

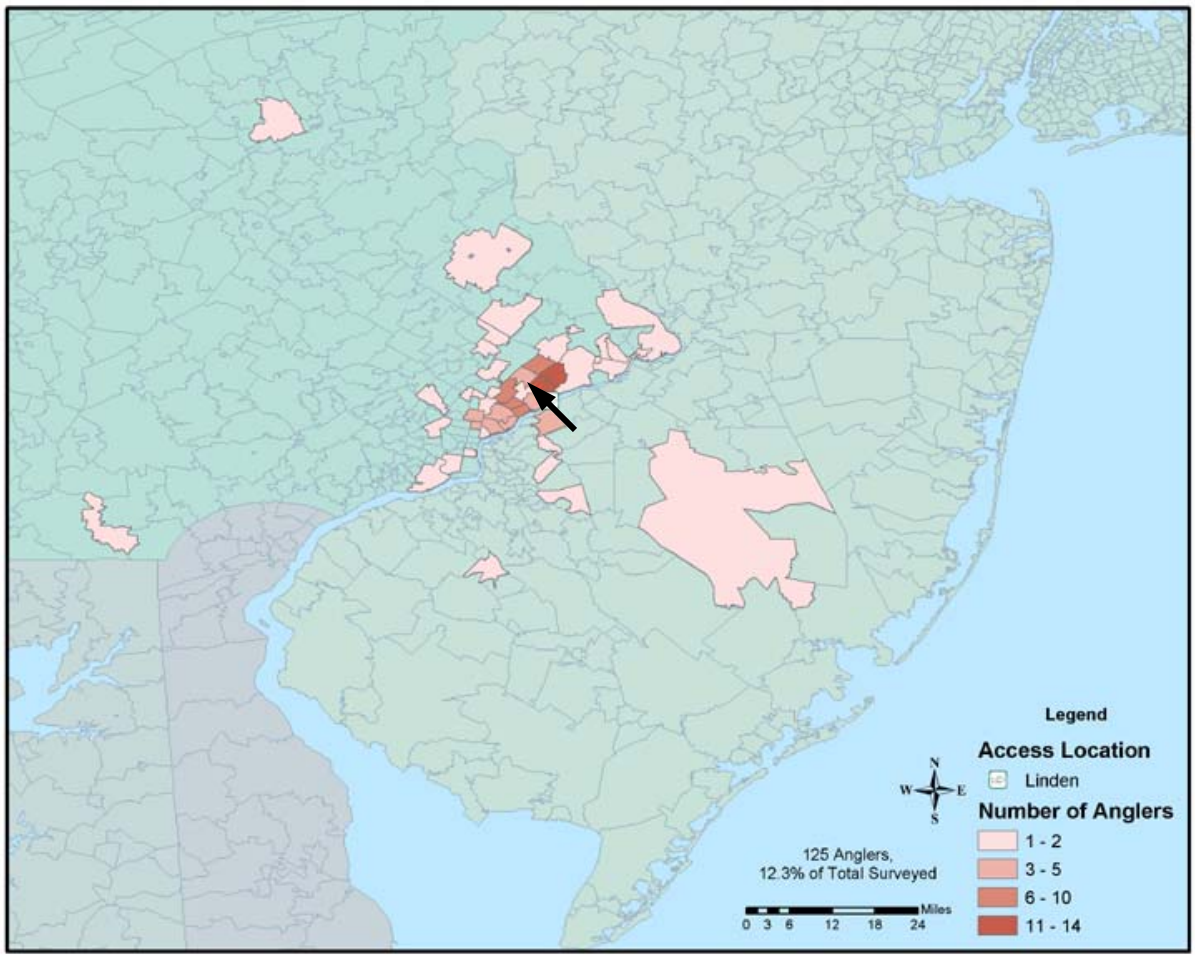

Figure 2. Residential densities by zip code areas as reported by anglers at Linden Avenue, Philadelphia County, PA. An arrow indicates the site location. Raw data are presented.

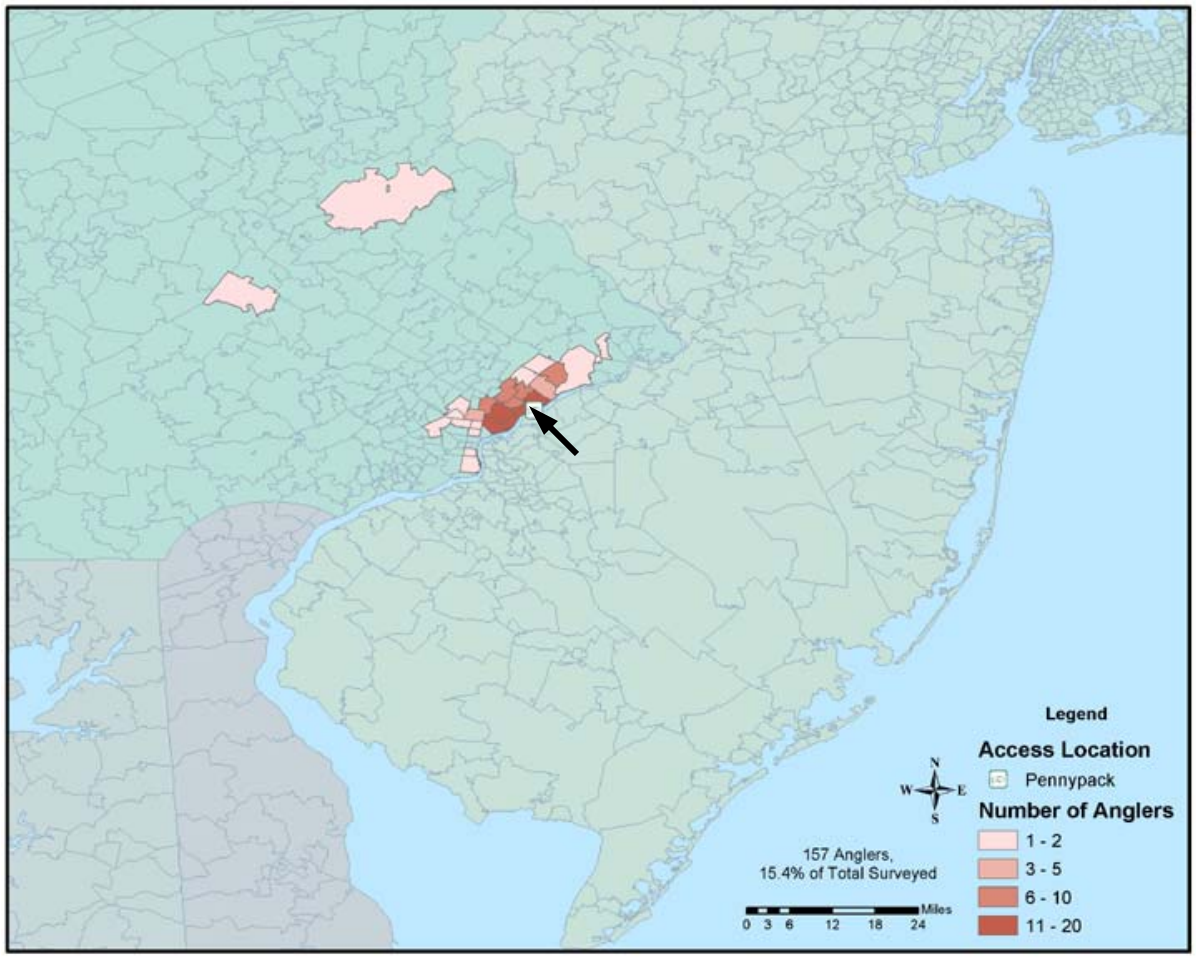

Figure 3. Residential densities by zip code areas as reported by anglers interviewed at Pennypack Park, Philadelphia County, PA. An arrow indicates the site location. Raw data are presented.

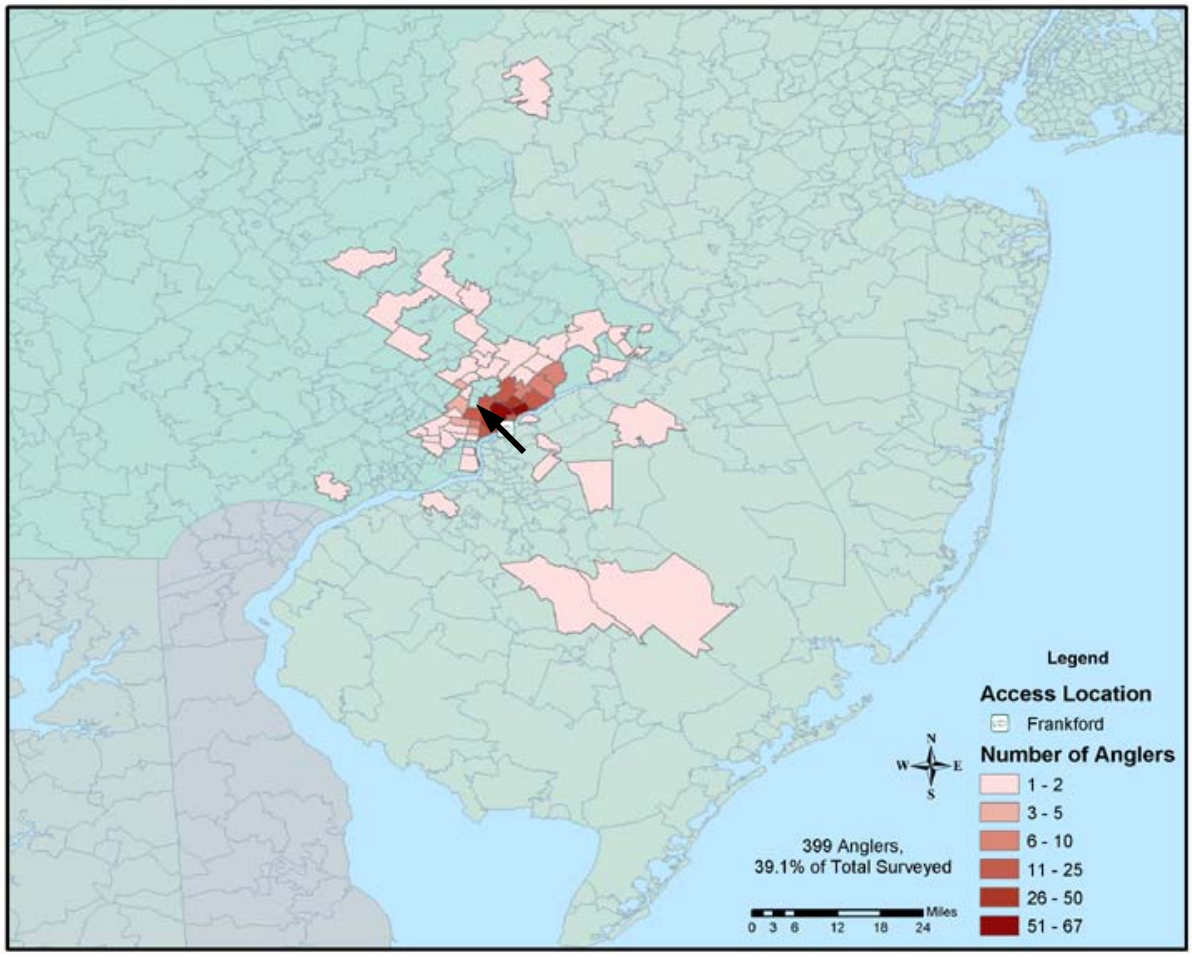

Figure 2. Residential densities by zip code areas as reported by anglers at Frankford Arsenal, Philadelphia County, PA. An arrow indicates the site location. Raw data are presented.

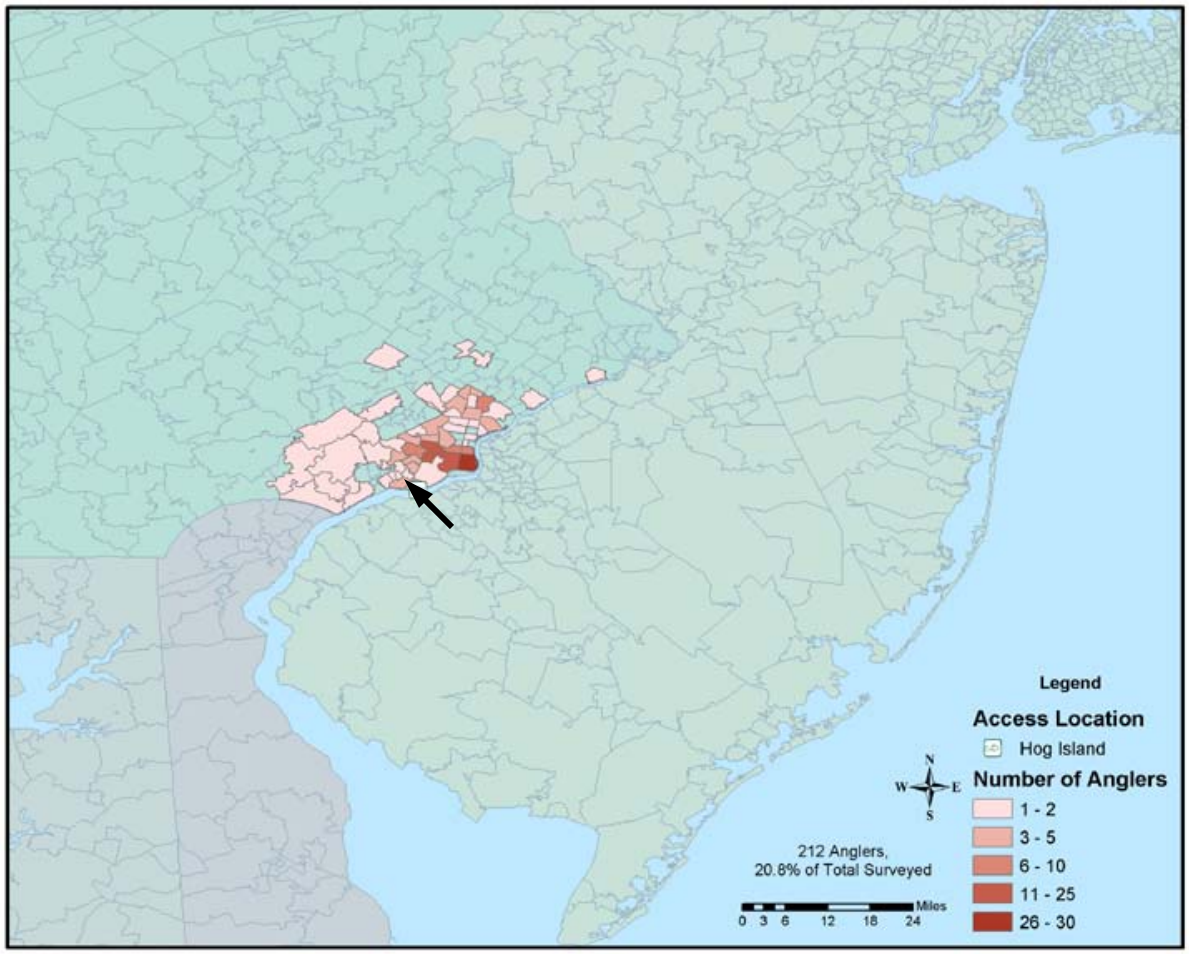

Figure 3. Residential density by zip code area as reported by anglers who were interviewed at Hog Island, Delaware County, PA. An arrow indicates the site location. Raw data are presented.

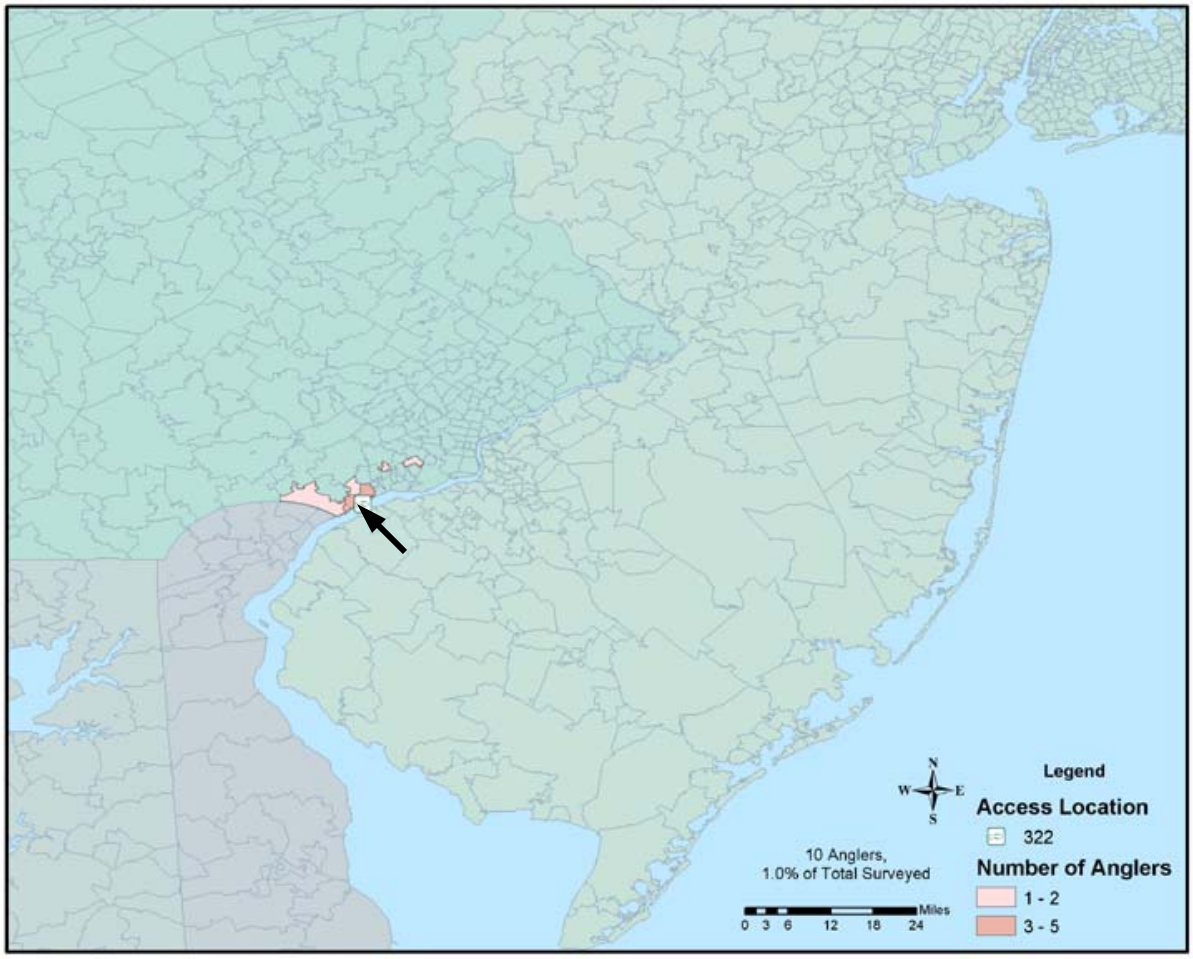

Figure 4. Residential density by zip code area as reported by anglers at Barry Bridge Park (322), Delaware County, PA. An arrow indicates the site location. Raw data are presented.

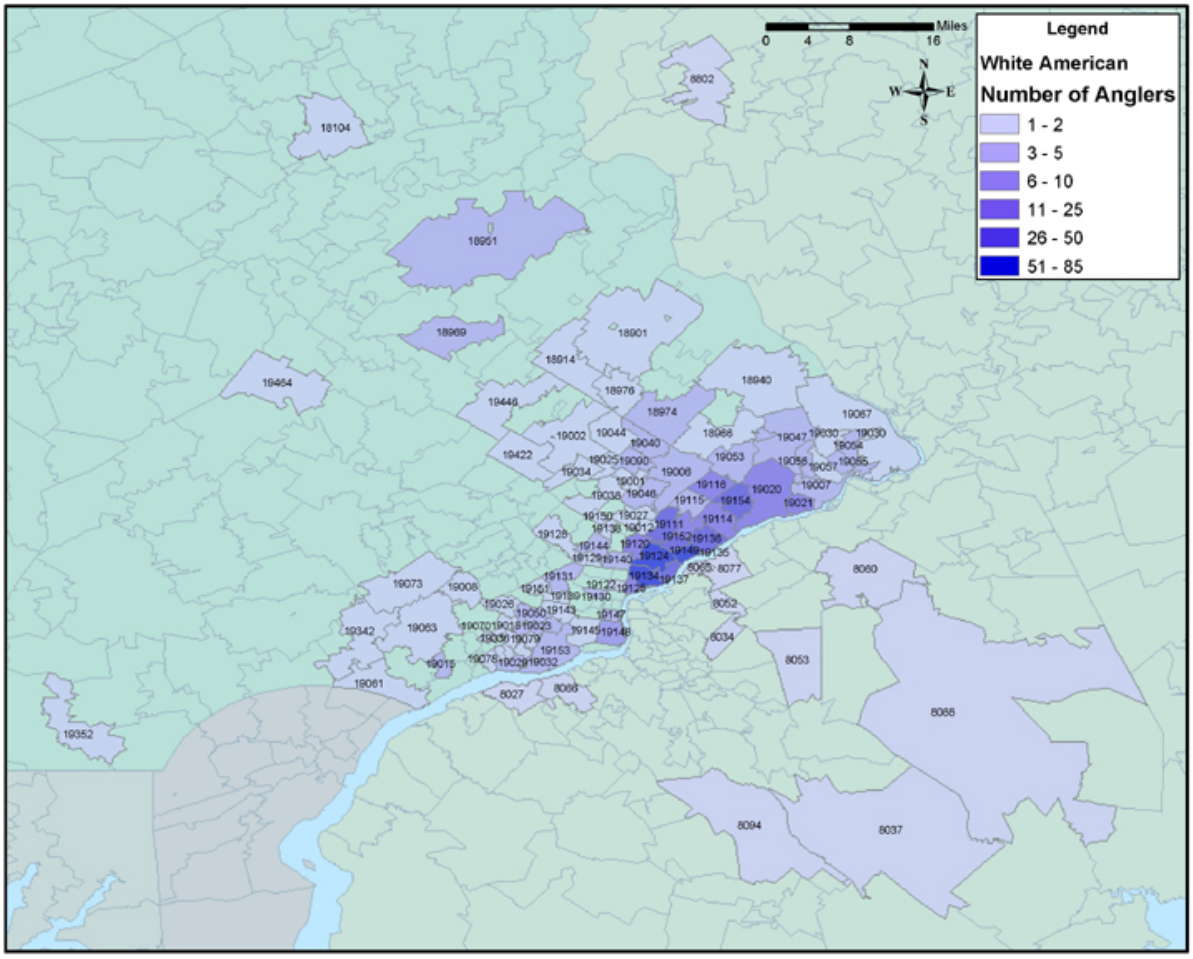

Figure 5. Residential density by zip code area as reported by white American shore anglers. Data presented are raw.

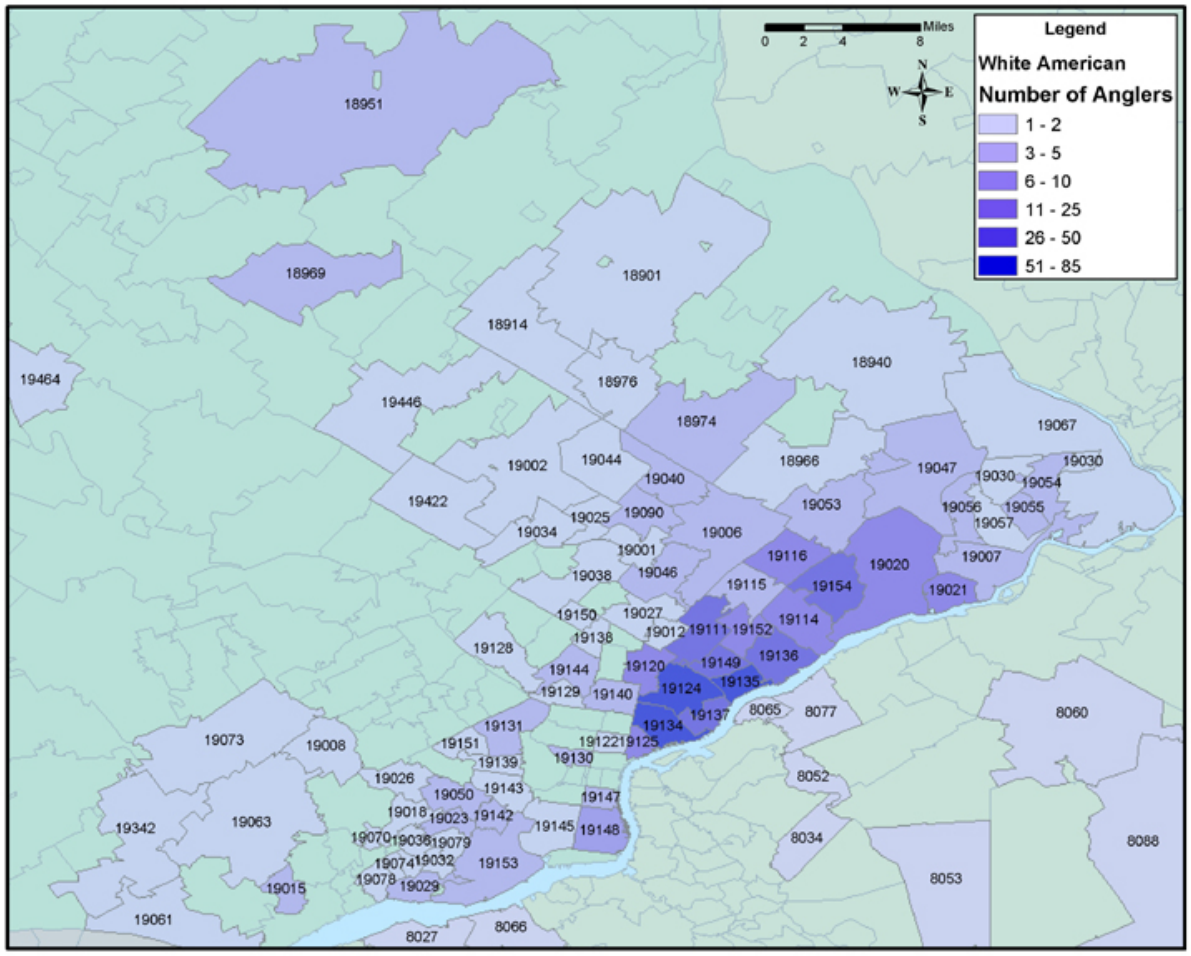

Figure 6. Greater Philadelphia residential density by zip code area as reported by White American shore anglers. Data presented are raw.

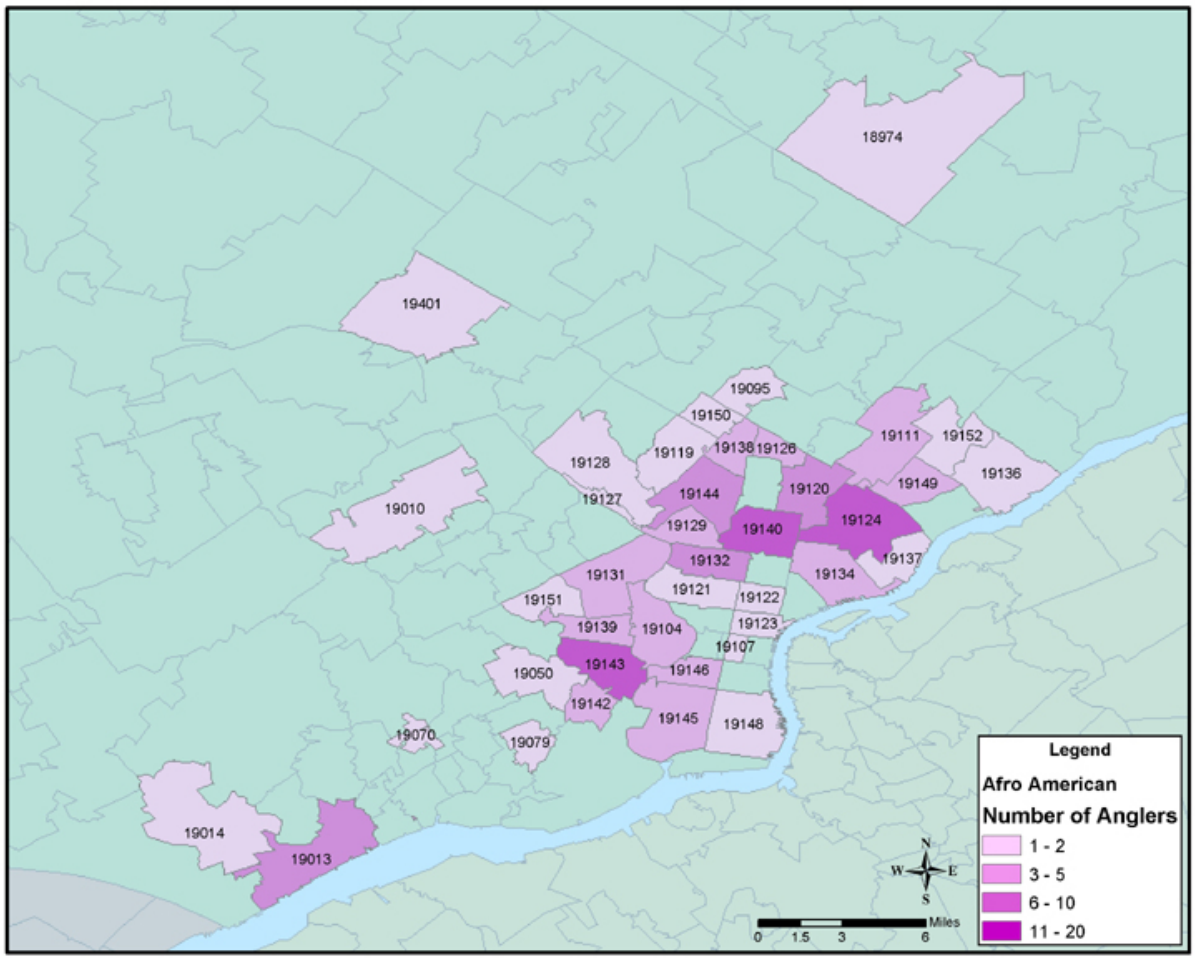

Figure 7. Residential density by zip code area as reported by Afro American shore anglers. Data presented are raw.

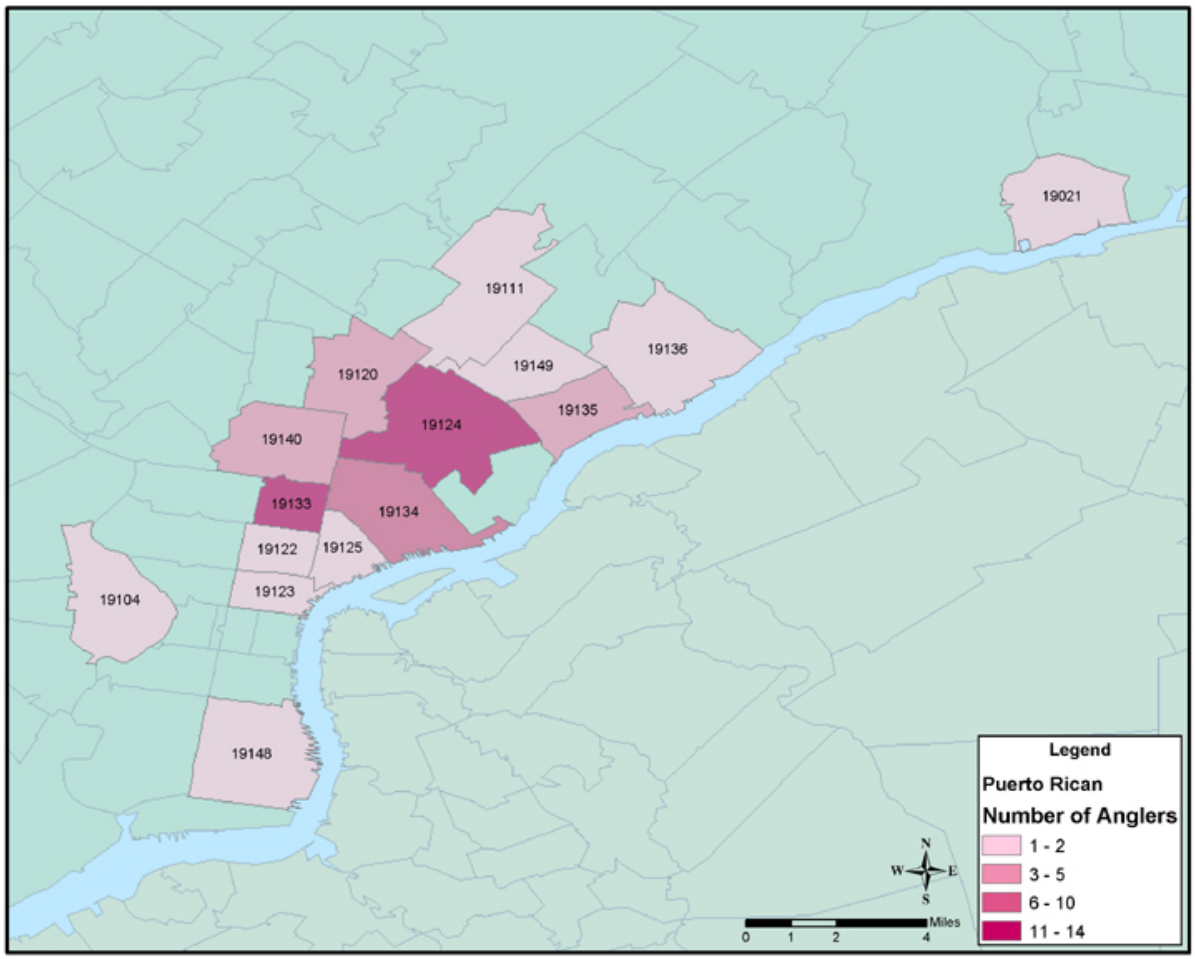

Figure 8. Residential density by zip code area as reported by Puerto Rican shore anglers. Data presented are raw.

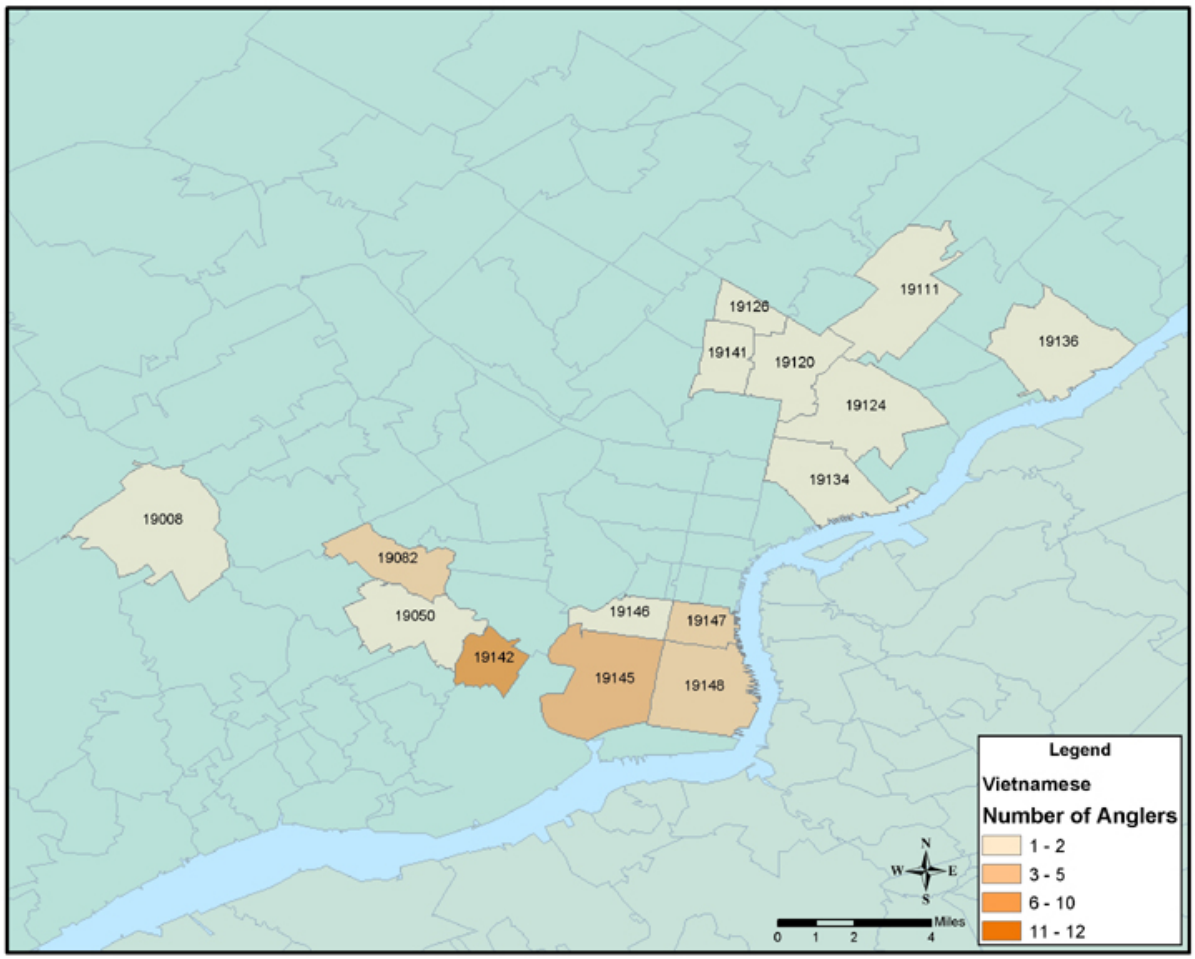

Figure 9. Residential density by zip code area as reported by Vietnamese shore anglers. Data presented are raw.

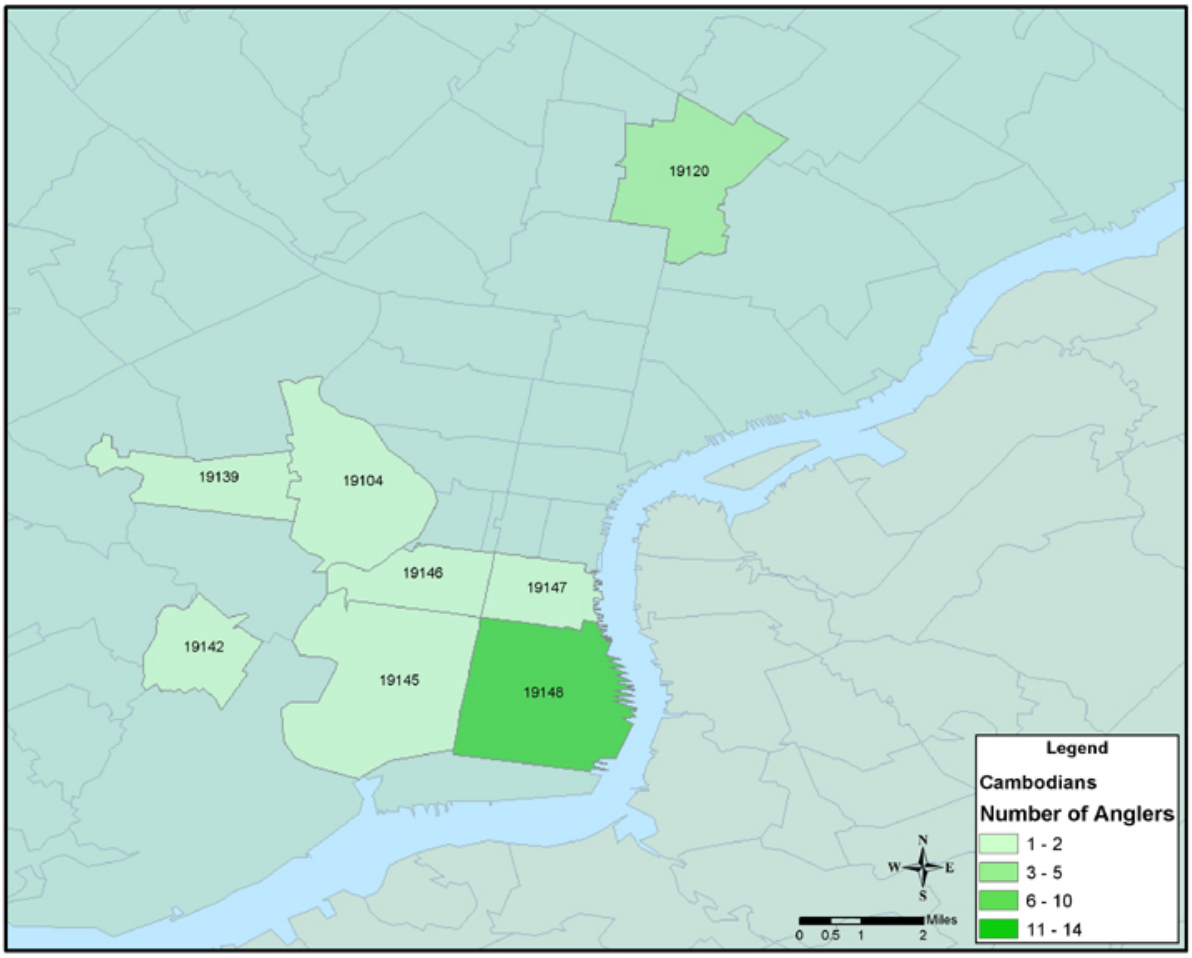

Figure 10. Residential density by zip code area as reported by Cambodian shore anglers. Data presented are raw.

Appendix A

Angler Questionnaire

PRE-INTERVIEW OBSERVATIONS

Creel Clerk	
Shift ID (Shift Start Time from Shift Record Sheet): _____-_____-03,_____: (for example, 1-Feb-03, 10:23 am)	
Interview Start Time	Number of People Fishing in Group
Boat Fishing ☐ Shore Fishing ☐ *[check one ✓]*	Fishing License: PA ☐ NJ ☐ NY ☐ DE ☐ None Visible ☐
Any Fish Visible? If so, how many? _____	Cooking Fish On-Site: ☐ Yes ☐ No

Hello, I'm _____ from Penn State University. *[if they want more information: Pennsylvania Sea Grant and the Partnership for the Delaware Estuary]*. I'm doing a survey of fishing activities along the Delaware River to learn more about the fishing and eating habits of Delaware River anglers. This is a scientific study, and we are not connected to any kind of enforcement agency. If you are willing to participate, your name will not be recorded.

1. May I ask you some questions? It should take about ten minutes.

___ yes *[go to 2]*
___ no *[end of interview]*

If no, did there appear to be a language barrier?
___ yes
___ no

If possible, please record the probable ethnicity of the angler or group of anglers who don't want to participate:

___ White
Latino
nationality *[if known]* _____
___ Asian
nationality *[if known]* _____

___ Black/ African American
nationality *[if known]* _____

___ Other _____

2. Have you already been interviewed ***this*** year for this survey?

___ yes *[end of interview]*
___ no

3. What are you fishing for today? *[Don't read this list, just check the appropriate answer/s.]*

___ Eel
___ Perch
___ Channel Catfish
___ Flathead Catfish
___ Striped Bass
___ Carp
___ Small Mouth Bass
___ Anything that bites
___ Other *[please list]* _____

4. What time did you start fishing today?

_____ AM
PM

5. Do you fish at other locations, or just here?

___ just here
___ other locations

[if other locations] Are any of those locations on this map? [Record the numbered access points, indicate street address, or as "location between A and B." If the location is not on the map, please write location below including the state.]

_____

6. I'd like to ask you a few questions about your catch. What have you caught so far today? *[Enter information about today's catch in the chart below. Write in other types of fish mentioned in space provided.]*

Type of Fish	# Caught	Released ✓	Kept ✓	Observed or Recalled	
				O	R
Eel					
White Perch					
Channel Catfish					
Flathead Catfish					
Striped Bass					
Carp					
Small Mouth Bass					

7. Over the past year, how often do you think you ate each of the following types of Delaware River wild caught fish? *[Read each fish and ✓ answer or fill in number. In blank columns, indicate type of fish in accordance with other fish listed in question 6]*

	Several times/ week (enter #)	1 meal/ week ✓	2 meals/ month ✓	1 meal/ month ✓	6 meals/ year ✓	Never ✓
Eel						
White Perch						
Channel Catfish						
Flathead Catfish						
Striped Bass						
Carp						
Small Mouth Bass						

8. We would like to know what you do with the fish you catch. Which of the following statements are true: *[✓ answer]*

___ I release all the fish I catch *[Go to question 13]*
___ People in my household eat the fish I catch. *[Go to 9]*
___ I give the fish away to friends to eat. *[Go to question 13]*
___ I give the fish away, and I don't know who eats them. *[Go to question 13]*
___ I sell the fish I catch. *[Go to question 13].*

9. Who usually cooks the fish that you catch? *[✓ answer]*

Sex		Relation ✓
M	F	___ Self
M	F	___ Spouse
M	F	___ Parent
M	F	___ Grandparent
M	F	___ Child
M	F	___ Sibling
		___ Other _____

10. I'd like to ask you some questions about the people who eat the fish that you catch. Beginning with yourself, could you list all the people in your household - I don't need their names, just their ages, if they are male or female, and whether or not they eat wild caught fish. *[Use one line per person.]*

Male ✓	Female ✓	Age	Eats wild caught fish ✓	Doesn't eat wild caught fish ✓
Interviewee				

11. Are any of the women you mentioned pregnant? *[Place a "p" next to the appropriate entry above.]*

___ yes
___ no

12. I would like to ask you some questions about how you prepare and cook your wild fish. Do you: *[Read the key aloud after the first two questions, ie: Do you trim/ remove the fat along belly: never, rarely, sometimes, etc. You may refer to diagram for trimming questions. Circle the number to match the following key:]*

1= never
2= rarely
3= sometimes
4= usually
5= always

Trim or remove the fat along the belly or back	1	2	3	4	5
Remove the skin of catfish	1	2	3	4	5
Remove the skin of eel	1	2	3	4	5
Remove the skin of other fin fish	1	2	3	4	5
Eat entire fish, gutted	1	2	3	4	5
Eat entire fish, not gutted	1	2	3	4	5
Use fish parts such as liver/ kidney in cooking	1	2	3	4	5
Freeze, dry, or can fish for later use	1	2	3	4	5

13. How concerned are you about potential health risks that fish caught from the Delaware River may have on you and your family?

___ very
___ somewhat
___ not at all

14. How safe do you think the fish you catch from the Delaware River are to eat, compared to store-bought or restaurant fish?

___ Safer than store-bought or restaurant
___ Just as safe as store-bought or restaurant
___ Not as safe as store-bought or restaurant

Some wild fish in the Delaware River contain contaminants that may be harmful if too many meals are eaten. Because of this, the Commonwealth of Pennsylvania issues a Health Advisory, which recommends eating limits on some local fish.

15. Prior to this survey, had you heard of this advisory?

___ yes *[go to 16]*
___ no *[go to 18]*

16. Can you tell me what the advisory recommends for ___? *[Refer to question 6 and answer with the 2 largest catches of the day when asking this question. If there is no catch recorded, refer to question 7 and use the 2 fish most eaten, wording the question appropriately. Read aloud the choices listed below. . If there is nothing listed in either chart, go to 18.]*

Catch 1 _____	Catch 2 _____
___Unlimited, no advisory	___Unlimited, no advisory
___1 meal/ week	___1 meal/ week
___2 meals/ month	___2 meals/ month
___1 meal/ month	___1 meal/ month
___6 meals per year	___6 meals per year
___ Do not eat	___ Do not eat
___ Don't know	___ Don't know

17. In the past year, have you tried to keep all your consumption of wild fish within the amount suggested by the advisory?

___ yes
___ no

18. What possible health problems do you think eating fish caught from the Delaware River could lead to?

Since I haven't asked for your name, your answers to the following questions will remain confidential and cannot be connected to you personally in any way. We ask for this information so that we can learn generally about local anglers.

19. Could you please tell me the closest intersection to your home to so that we can identify your neighborhood?

Closest intersection:

_____

Zip Code _____

[if outside Philadelphia]
City _____ State ___

20. May I ask your heritage or ethnic background?

___ **White, Caucasian or Anglo**
Other_____

___**Latino**
___ Mexican
___ Dominican
___ Puerto Rican
___ Cuban
Other _____

___**Black**
___ African American
___ Jamaican
Other _____

___**Asian**
___ Vietnamese
___ Cambodian
___ Korean
___ Chinese
Other _____

21. What language is spoken most often in your home?

___ English
___ Spanish
___ Asian
___ Vietnamese
___ Korean
___ Chinese
___ Cambodian
Other Asian dialect _____
Other _____

22. What language do you read or understand the best?

___ English
___ Spanish
___ Asian
___ Vietnamese
___ Korean
___ Chinese
___ Cambodian
Other Asian dialect _____
Other _____

23. We are looking for ways to distribute information about how to safely eat wild fish. Can you suggest a place in your neighborhood where we might provide a program or distribute information?

24. Are you currently employed?
___ No
___ Would rather not say
___ Yes

If yes, this past week (ending Saturday), did you work:
___ Part time
___ Full time
___ Not at all

Thank you very much for your time and effort to help us today. Have a good day!

Interview End Time ____:___ am
pm